STAR

ENGINEERING CHANGE NOTICE

0035794

1. ECN 135976L

Proj. ECN

2. ECN Category (mark one) Supplemental ☐ Direct Revision ☐ Change ECN ☒ Temporary ☒ Supersedure ☐ Discovery ☐ Cancel/Void ☐	3. Originator's Name, Organization, MSIN, and Telephone No. D.W. Bergmann/12730/S6-01/3-4618	4. Date January 31, 1990
	5. Project Title/No./Work Order No. Safety Evaluation -- Process Distillate ~~Discharge to Tank Farms~~	6. Bldg./Sys./Fac. No. 202-A
		7. Impact Level 3
	8. Document Number Affected (include rev. and sheet no.) SD-HS-SAR-001, Rev 5	9. Related ECN No(s). 134976L
		10. Related PO No. N/A

11a. Modification Work	11b. Work Package Doc. No.	11c. Complete Installation Work	11d. Complete Restoration (Temp. ECN only)
☒ Yes (fill out Blk. 11b) ☒ No (NA Blks. 11b, 11c, 11d) DWB 2/1/90	N/A	DWB 2/1/90 N/A David Bergmann 2/1/90 Cog. Engineer Signature & Date	DWB N/A Cog. Engineer Signature & Date

12. Description of Change

This ECN modifies the effected pages to (1) reference [OH] concentration limits instead of pH, (2) provide administrative control requirements during equipment failures, and (3) modifies effected sections of fault tree analysis in Appendix B.

Replace page 10 of ECN 134976L with page 3 of ECN 135976L
Replace page 12 of ECN 134976L with page 4 of ECN 135976L
Replace page 13 of ECN 134976L with page 5 of ECN 135976L
Replace page 18 of ECN 134976L with page 6 of ECN 135976L
Replace page 27 of ECN 134976L with page 7 of ECN 135976L
Replace page 36 of ECN 134976L with page 8 of ECN 135976L
Replace page 39 of ECN 134976L with page 9 of ECN 135976L

13a. Justification (mark one)	13b. Justification Details
Criteria Change ☒ Design Improvement ☐ Environmental ☐ As-Found ☐ Facilitate Const. ☐ Const. Error/Omission ☐ Design Error/Omission ☐	Clarification of PDD to Tank Farms Safety Evaluation is necessary to ensure feasibility of operations.

14. Distribution (include name, MSIN, and no. of copies)	RELEASE STAMP
	DATE FEB 01 1990 station #1

ENGINEERING CHANGE NOTICE

1. ECN (use no. from pg. 1): 135976L

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
☐ Yes	Additional ☐	$ N/A	Additional ☐	$ N/A	Improvement ☐	N/A
☒ No	Savings ☐	$ N/A	Savings ☐	$ N/A	Delay ☐	N/A

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	☐	Seismic/Stress Analysis	☐	Tank Calibration Manual	☐
Functional Design Criteria	☐	Stress/Design Report	☐	Health Physics Procedure	☐
Operating Specification	☐	Interface Control Drawing	☐	Spares Multiple Unit Listing	☐
Criticality Specification	☐	Calibration Procedure	☐	Test Procedures/Specification	☐
Conceptual Design Report	☐	Installation Procedure	☐	Component Index	☐
Equipment Spec.	☐	Maintenance Procedure	☐	ASME Coded Item	☐
Const. Spec.	☐	Engineering Procedure	☐	Human Factor Consideration	☐
Procurement Spec.	☐	Operating Instruction	☐	Computer Software	☐
Vendor Information	☐	Operating Procedure	☒	Electric Circuit Schedule	☐
OM Manual	☐	Operational Safety Requirement	☐	ICRS Procedure	☐
FSAR/SAR	☐	IEFD Drawing	☒	Process Control Manual/Plan	☒
Safety Equipment List	☐	Cell Arrangement Drawing	☒	Process Flow Chart	☐
Radiation Work Permit	☐	Essential Material Specification	☐	Purchase Requisition	☐
Environmental Impact Statement	☐	Fac. Proc. Samp. Schedule	☒		☐
Environmental Report	☐	Inspection Plan	☐		☐
Environmental Permit	☐	Inventory Adjustment Request	☐		☐

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number/Revision
WHC-CM-5-24, Add. I, 6/28/89	H-2-63250 Rev 17	
FSS-P-080-00002 Rev E-3	H-2-63272 Sh 1 Rev 10 Sh 2 Rev 17	PO-380-006 Rev B-3

20. Approvals

OPERATIONS AND ENGINEERING — Signature	Date	ARCHITECT-ENGINEER — Signature	Date
Cog./Project Engineer DW Bergmann David Bergmann	1/31/90	PE	
Cog./Project Engr. Mgr. RJ Thompson EE Bordeu for	1-31-90	QA	
QA VL Wagner Veronica Wagner	1-31-90	Safety	
Safety JW Bloom J W Bloom	2/1/90	Design	
Security		Other	
Proj.Prog./Dept. Mgr. MA Payne	1/31/90		
Def. React. Div.			
Chem. Proc. Div.			
Def. Wst. Mgmt. Div. DG Baide DBaide	1/31/90	DEPARTMENT OF ENERGY	
Adv. React. Dev. Div.			
Proj. Dept.			
Environ. Div. DB Howe	2/1/90	ADDITIONAL	
IRM Dept.			
Facility Rep. (Ops) SD Godfrey SD Godfrey	1/31/90		
Other J. M. Siemer Systems Safety Analysis	1/31/90		
M R Miller : SBAC P&FS	2/1/90		

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	ENGINEERING	CONSTRUCTION	
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QA	VL Wagner Veronica Wagner	1-31-90
Safety	JW Bloom J W Bloom	2/1/90
Security		
Proj.Prog./Dept. Mgr.	FOR MA Payne J.L. Michatt	1/31/90
Def. React. Div.		
Chem. Proc. Div.		
Def. Wst. Mgmt. Div.	DG Baide D Baide	1/31/90
Adv. React. Dev. Div.		
Proj. Dept.		
Environ. Div	DB Howe D Howe for	2/1/90
IRM Dept.		
Facility Rep. (Ops)	SD Godfrey DRI S Godfrey	1/31/90
Other	J. M. Siemer Systems Safety Analysis	1/31/90
	MR Miller : SEAC P4FS	2/1/90

ARCHITECT-ENGINEER	Signature	Date
PE		
QA		
Safety		
Design		
Other		
DEPARTMENT OF ENERGY		
ADDITIONAL		

provide continuous sodium hydroxide/sodium nitrite adjustment while TK-G5A will operate on a demand basis.

2.0 PROCESS CONTROL

2.1 CONTROL SYSTEM

To ensure that the applicable Operational Safety Requirements (OSRs), Limiting Condition of Operations (LCOs), and Limiting Control Settings (LCSs) are met, the following pH control system will be implemented for the PDD to Tank Farms transfer (Figure 2).

A four element system will be used to control/monitor the pH of the PDD being discharged to Tank Farms. These elements are: (1) sodium hydroxide addition to the K4 Sample Pot, (2) an in-line pH probe on the K4 to TK-G7 transfer line, (3) sampling of TK-G7, and (4) sodium hydroxide/sodium nitrite addition to TK-G7. The existing K4 Sample Pot sodium hydroxide addition equipment will be used as the primary control system. The position of the flow control valve will be manually controlled by operating personnel based on readings from the in-line pH probe. Sodium hydroxide/sodium nitrite will also be added directly to TK-G7 from TK-G5A as a back-up pH adjustment in response to samples and alarms.

The in-line pH probe will serve a dual purpose: (1) as the primary hydroxide concentration ([OH]) control device, and (2) a low [OH] indicator. This device will be equipped with a low alarm, a low-low alarm, and a safety alarm. The alarms will be set at an [OH] of 0.01$\underline{M}$, 0.001$\underline{M}$, and 0.0001$\underline{M}$, respectively. The reponse/recovery actions for all three alarm conditions are listed in Figure 3.

Tank G7 will be sampled once every four hours. Once adequate [OH] control is demonstrated, sampling frequencies may decrease to once every eight hours. Tank G7 samples will be used to ensure that the pH probe is reading properly, and as a record of the actual [OH] being discharged to Tank Farms. Additional sampling of TK-G7 will be performed in the event that a low-low or safety alarms are activated.

The flowrate of neutralized process condensate from the K4 Sample Pot will typically be 25-30 gpm. Peak flow conditions as high as 45 gpm could be seen during condensate recycle start-up.

The process response time for a sodium hydroxide addition system failure indicates the [OH] in TK-G7 will drop to 0.0001$\underline{M}$ after 13 hours, (assumes 6,000 gallons of solution in TK-G7 and PDD flow of 30 gpm). Additionally, under the same conditions, an [OH] of 0.0001$\underline{M}$ would be seen at the pH probe in ten minutes. Calculations are attached in Appendix A.

To ensure that sufficient response times are maintained a minimum tank volume of at least 3,000 gallons will be specified in operating procedures.

PROBE ALARM RESPONSES

Low Alarm/Set Point, [OH] = 0.01M

- Adjust sodium hydroxide/sodium nitrite flow K4 Sample Pot
- If [OH] is less than 0.01M for one hour, follow low-low alarm responses

Low-Low Alarm/Set Point, [OH] = 0.001M

- Add sodium hydroxide/sodium nitrite to TK-G7 (calculated volume)
- Adjust sodium hydroxide/sodium nitrite flow to K4 Sample Pot
- Sample TK-G7
- If [OH] is less than 0.001M for one hour, follow safety alarm responses

Safety Alarm/Set Point, [OH] = 0.0001M

- Shutdown transfer to Tank Farms
- Notify Tank Farms
- Add sodium hydroxide/sodium nitrite to TK-G7 (calculated volume)
- Adjust sodium hydroxide/sodium nitrite flow to K4 Sample Pot
- Sample TK-G7
- Wait for sample results. If [OH] >0.01M and [NO_2] > .011M obtain approval from Tank Farms to restart transfer

TANK G7 SAMPLE ANALYSIS RESPONSES

Process Control Limit, [OH] = <0.01M

- Add sodium hydroxide/sodium nitrite to TK-G7 (calculated volume)
- Resample TK-G7. If [OH] is less than 0.01M, initiate control feature limit responses

Control Feature Limit, [OH] = <0.001M

- Shutdown transfer to Tank Farms
- Notify Tank Farms
- Add sodium hydroxide/sodium nitrite to TK-G7 (calculated volume)
- Adjust sodium hydroxide/sodium nitrite flow to K4 Sample Pot
- Sample TK-G7.
- Wait for sample results. If [OH] >0.01M and [NO_2] >.011M, obtain approval from Tank Farms to restart transfer

FIGURE 3. PROCESS DISTILLATE DISCHARGE TO TANK FARMS

The PDD to Tank Farms transfer can be maintained during a pH probe failure for a maximum of 24 hours, provided the following conditions are immediately implemented.

1. Tank G7 is sampled once every two hours.

2. Surveillance on TK-153 drop-out rate is increased.

Failure to restore operation of the pH probe within 24 hours will require concurrence from the Plant Manager, and PUREX Nuclear Safety to allow continued transfer of PDD to Tank Farms.

2.2 STREAM CHARACTERIZATION SAMPLING AND CALIBRATION CONTROLS

Two conditions exist which will require a minimum of one of the control features in the PDD to Tank Farms control system to be deactivated. These situations are:

1. Characterization sampling of the PDD. The PUREX Plant has committed to the Washington State Department of Ecology to provide post-1987 PDD characterization samples.

2. Calibration of pH probe. Required to ensure accurate monitoring of K4 Sample Pot pH.

The required frequencies for each of these events will be weekly.

To ensure that an acidic solution is not discharged during calibration or characterization sampling the steps outlined in Figure 4 will be followed. The fault tree analysis in Appendix B determined that the probability of an acidic solution being discharged during calibration and characterization sampling to be 6.1×10^{-6} and 1.7×10^{-3} occurrences during the stabilization run (assumed duration of six weeks), respectively.

2.3 PROCESS DISTILLATE DISCHARGE COMPOSITION

~~The only changes in the PDD composition during the stabilization run will be the required chemical additives for storage at Tank Farms. These chemicals,~~ sodium nitrite and sodium hydroxide, will be added to meet the requirements of Reference 1 (Table 1). The intent of Reference 1 is to prevent excessive corrosion of the mild-steel storage tanks and transfer lines. The expected concentrations of the non-radioactive constituents in the PDD before and after neutralization are included in Tables 2 and 3 (Reference 10). The radionuclide concentrations in the PDD will remain unchanged (Table 4 and Reference 2).

The discharge of potentially listed compounds to the PUREX process have ceased. If any of the potentially listed compounds remain in PUREX process streams, they will not be discharged to the environment. The PDD generated during the stabilization run will be stored at Tank Farms until a determination of the actual environmental classification of the PDD is completed.

3.0 ACCIDENT EVALUATION

This section will address the three identified accident scenarios, their consequences, and probabilities resulting from the transfer of PDD to Tank Farms.

3.1 ACIDIC PROCESS DISTILLATE DISCHARGE

Failure of the pH adjustment system would result in acidic solution (pH = 4) being transferred to Tank Farms. The transfer of this solution would cause abnormally high corrosion rates in the mild-steel transfer lines and double-shell storage tanks at Tank Farms. Failure of the primary transfer line would result in the activation of the leak detector(s) at Tank Farms. Activation of the leak detector(s) will automatically shut down the PDD transfer by interrupting power to the TK-G7 pump (Reference 4). This type of accident would cause equipment damage only. No environmental releases would occur as a result from this scenario, due to the presence of encasements around the primary transfer line. A schematic of the entire transfer system is included in Figure 1.

Transferring acidic solution to Tank Farms would occur only if all three of the following events occurred:

1. Sodium hydroxide solution to the K4 Sample Pot fails.

2. Operators fail to respond to pH probe alarms. Failure to respond to the alarm condition will not discharge on acidic solution for approximately 13 hours.

3. Operating personnel fail to respond to sample analysis results from TK-G7.

The probability of all three of these events occurring simultaneously is very unlikely.

To ensure continuous and accurate pH monitor readings, a probe check will be performed once every four to eight hours, along with weekly probe calibrations. If the pH probe cannot be calibrated or the probe's reading and TK-G7 sample deviate significantly, the actions outlined in Section 2.1 will be followed.

Shutting down the TK-G7 to Tank Farms transfer will have no operational impacts for approximately five hours (based on 30 gpm flow and 6,000 gallons in TK-G7). Any delays beyond this will cause the neutralized PDD to overflow to canyon sumps and will require eventual shutdown of solvent extraction.

A fault tree analysis of the PDD to Tank Farms transfer system (Appendix B) determined that the probability of an acidic PDD being transferred to Tank Farms during the stabilization run to be 5×10^{-4} occurrences (assumed duration of six weeks).

Safety, shall determine and document what alternate action will be taken. The pH monitors for the process condensate stream shall be operational prior to start-up of J8 and K4 concentrators or flow being sent to the PDD header, without exception.

6.7.2 <u>Discussion</u>

This requirement ensures that continuous pH monitoring of PDD discharges to the crib are in place. Since PDD will not be discharged to the crib for the stabilization run, this limit does not apply. The pH of the PDD will be controlled at the levels required by Tank Farms. To ensure proper pH control, a pH probe will be installed on the K4 to G7 transfer route, and pH samples will be taken from TK-G7.

6.8 ADMINISTRATIVE CONTROL SYSTEMS
(Reference 8, Addendum 1, Section 14)

This chapter of the Process Control Manual sets the administrative requirements for all systems within the PUREX facility. The PDD to Tank Farms transfer system will adhere to this requirement in every way.

6.9 NEW PROCESS DISTILLATE DISCHARGE pH LIMITING CONTROL SETTING

To ensure that adequate [OH] control is maintained, for the continuous transfer of PDD to Tank Farms during the stabilization run, the following LCS will be added to Addendum I, Section 8.6.1 of the Process Control Manual (Reference 8). This requirement reflects the responses outlined in Section 2.0 of this document.

For the transfer of the PDD stream to underground storage, the [OH] shall be routinely greater than 0.01<u>M</u>, as measured by sample analysis of TK-G7. If the sample analysis has a [OH] less than 0.01<u>M</u>, add caustic to TK-G7 and resample. If TK-G7 sample analysis is ever less than 0.001<u>M</u>, the transfer to underground storage shall be immediately stopped. The transfer shall not be restarted until the [OH] in TK-G7 is confirmed to be greater than 0.01<u>M</u>.

7.0 CONCLUSIONS

Based on the above discussions, the proposed system to continuously discharge PDD to Tank Farms poses no significant risks to the public, personnel or the environment.

To ensure that the continuous and safe operation of the PDD to Tank Farms transfer system, the requirements outlined in this safety evaluation must be incorporated into the applicable operating documents. A summary of the requirements identified in this document is provided in Appendix D.

Component failure rate data was derived from report DPST-CFRP-80-113, "Component Failure-Rate Data with Potential Applicability of the Hot Experimental Facility", while human error rates were taken from NUREG/CR-1278, "Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications". The calculated probability of occurrence of the top event, Acidic Discharge to Tank Farms, was 2×10^{-3}. This event would be characterized as highly unlikely, given the controls included in the model.

In the event that the pH probe is not used for control purposes (i.e. probe failure) the over all probability of the top event will increase to 2.9×10^{-3} (calculated by removing the C-3 branch of the fault tree). Therefore, operation of the transfer system for limited periods of time, without the pH probe will not significantly affect the overall risk of the top event.

The probability of a leak during the six-week time frame can be roughly derived by assuming an overall failure rate for the transfer piping of about 10^{-6}/hour. Individual component and piping failure rates are about an order of magnitude lower than this figure, so it was assumed to be conservative. Multiplying this by the number of hours in six weeks, the probability of a leak during the stabilization run is about 1×10^{-3}, or "unlikely." The fact that the bulk of the transfer piping is new and will satisfactorily pass a system leak test makes this estimate even more conservative.

Because no seismic criteria was used in the design of the piping, the probability of the Hanford Design Basis Earthquake was used to determine the probability of a seismic event (piping assumed to fail). The probability of the Design Basis Earthquake is 2×10^{-5}/year; the probability in six weeks is 2.3×10^{-6}. The failure of the piping and equipment due to an earthquake is thus considered unlikely.

REFERENCES

1. A. H. Dexter, December 1980, Component Failure-Rate Data with Potential Applicability to the Hot Experimental Facility, DPST-CFRP-80-113, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, South Carolina

2. A. D. Swain and H. E. Guttmann, August 1983, Handbook of Human Reliability Analysis with Emphasis on Nuclear Power Plant Applications, NUREG/CR-1278, SAND80-0200, Sandia National Laboratories, Albuquerque, New Mexico

3. HPS-SDC-4.1, Rev. 1, Standard Architectural-Civil Design Criteria Design Loads for Facilities, Westinghouse Hanford Company, Richland, Washington (Draft)

Event Address	Event Description	Calculated Probability	Comments
Top	Acidic Discharge to Tank Farms	$P(A) + P(B) + P(C)$ $1.7\times10^{-3} + 6.1\times10^{-6} + 2.7\times10^{-4} = 2\times10^{-3}$	
A	Non-neutralized contents of TK-G7 discharged as a result of characterization sampling	$45 \cdot [P(A\ 1) + P(A\ 2)] =$ $45\ (3.8\times10^{-5}) = 1.7\times10^{-3}$	Special sampling performed 45 times
A 1	Failure to restore flow from TK-153 after sampling	$P(A\ 11) \cdot P(A\ 12) \cdot P(A\ 13) =$ $(1.0\times10^{-2})(.95)(.003) = 2.8\times10^{-5}$	
A 2	Discharge of non-neutralized TK-G7 during characterization sampling	$P(A\ 21) \cdot P(A\ 22) =$ $(.003) \cdot (.003) = 9\times10^{-6}$	
A 11	Normal sampling does not detect low pH in a timely manner	$Pc = (.009) + (.19) = .2$ $P\ (A\ 111) + P(A\ 112) =$ $(.009) + 1.7\times10^{-3} = 1.07\times10^{-2}$	
A 12	pH alarm light not noticed for six hours	$P(A\ 12) = .95$	
A 13	Operator does not restore flow from TK-153 prior to starting G7 pump	$P(A\ 13) = .003$	Table 20-7, Reference 2, Basic human error rate
A 21	Operator does not add sodium hydroxide spike	$P(A\ 21) = .003$	Table 20-7, Reference 2, Basic human error rate
A 22	Operator does not shut off G7 pump	$P(A\ 22) = .003$	Table 20-7, Reference 2, Basic human error rate

DISTRIBUTION SHEET

To	From	Page 1 of 1
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Project Title/Work Order: SAVETY EVALUATION -- PROCESS DISTILLATE DISCHARGE TO TANK FARMS

EDT No

ECN No 135976L

Name	MSIN	With Attach.	EDT/ECN & Comment	EDT/ECN Only
DG Baide	R1-51	X		
DK Bailey	S6-08	X		
MW Bowman	S5-80	X		
NC Boyter	R2-52	X		
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RE Van der Cook	S6-07	X		
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RL Walser	S5-80	X		
RJ Baumhardt	R2-40	X		
DD Wodrich	R2-23	X		
NW Kirch	R2-12	X		
KJ Moss	R2-08	X		
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